invention comprise controlling the polishing pad surface at a temperature at no greater than about 44°C, as by reducing the platen rotating speed to no greater than 40 rpm, thereby reducing static etching and, hence, dishing. It should be appreciated that the static etching rate should not be reduced to the extent that the polishing by-products generated during CMP can not be removed, e.g., dissolved. The polishing by-products generated during CMP can be flushed away with a high flow of chemical agent which can be recycled to reduce the cost of consumables.

IN THE CLAIMS:

Please cancel claims 45-58 without prejudice, and amend the following claims:

~~30~~. (Amended) A method of planarizing a substrate surface containing a copper or copper alloy layer disposed on a barrier layer comprising:

(a) polishing the substrate surface on a first platen with a first abrasive-free polishing composition to reduce a copper or copper alloy layer at a first removal rate; and

(b) polishing the substrate on a second platen with a second abrasive-free polishing composition to remove the copper or copper alloy layer at a second removal rate less than the first removal rate.

~~31~~. The method according to claim ~~30~~, further comprising removing the barrier layer on a third platen.

~~32~~. (Amended) The method according to claim ~~30~~, wherein the first removal rate is greater than about 5,000 Å per minute and the second removal rate is between about 1000 Å per minute and about 3,000 Å per minute.

~~33~~. The method according to claim ~~31~~, wherein the barrier layer comprises tantalum (Ta) or tantalum nitride (TaN) and is disposed on a dielectric material.

34. (Amended) The method according to claim 30, wherein polishing at the second removal rate is performed at a removal rate ratio of copper layer to barrier layer of greater than about 100:1.

35. The method according to claim 34, wherein polishing at the second removal rate is performed under conditions such that dishing within the dense array is about 300 Å or less.

36. (Amended) The method according to claim 35, wherein the first platen and the second platen each comprise a polishing pad mounted on a rotating, stationary, or linear platen.

37. (Amended) The method according to claim 36, wherein the first and second platens are rotated during polishing at less than about 60 rpm or first and second belts disposed on the first and second platens are moved linearly at a rate of less than about 30 inches per second.

38. (Amended) The method according to claim 36, further comprising cleaning the polishing pads by removing debris and polishing by-products.

39. (Amended) The method according to claim 30, further comprising recycling the first abrasive-free polishing composition, the second abrasive-free polishing composition, or both.

40. (Amended) The method according to claim 36, wherein the first abrasive-free polishing composition is delivered to the first platen at a flow rate of about 300 milliliters per minute or greater and the second abrasive-free polishing composition is delivered to the second platen at a flow rate of about 300 milliliters per minute or greater.

41. (Amended) The method according to claim 36, wherein the static removal rate of the copper or copper alloy by the first abrasive-free polishing composition and the second abrasive-free polishing composition is about 150 Å per minute or less.

42. (Amended) The method according to claim 30, further comprising exposing a polishing pad disposed on the first platen or the substrate surface to an inhibitor after polishing at the first removal rate and prior to polishing at the second removal rate.

43. (Amended) The method according to claim 42, further comprising exposing a polishing pad disposed on the second platen or the substrate surface to an inhibitor after polishing at the second removal rate and prior to removing the barrier layer.

44. (Amended) The method according to claim 36, further comprising:

exposing the first polishing pad or the substrate surface to an inhibitor after polishing at the first removal rate and prior to polishing at the second removal rate;

exposing the second polishing pad or the substrate surface to an inhibitor after polishing at the second removal rate; and

recycling the first abrasive-free polishing composition, the second abrasive-free polishing composition, or both.

45. (Cancelled) A computer-readable medium bearing instructions for planarizing a substrate surface, the instructions arranged, when executed by one or more processors, to cause the one or more processors to control a polishing system to perform the steps of:

(a) polishing the substrate surface on a first platen to reduce a copper or copper alloy layer at a first removal rate; and

(b) polishing the substrate on a second platen to remove the copper or copper alloy layer at a second removal rate, less than the first removal rate.

46. (Cancelled) The computer-readable medium of claim 45, wherein said instructions are further arranged for removing the barrier layer on a third platen.

47. (Cancelled) The computer-readable medium of claim 45, wherein said instructions are arranged for conducting step (a) at the first removal rate greater than about 5,000 Å per minute; and conducting step (b) at the second removal rate between about 1000 Å per minute and about 3,000 Å per minute.

48. (Cancelled) The computer-readable medium of method claim 46, wherein said instructions are arranged for polishing at the second removal rate at a selectivity of copper:barrier layer of greater than about 100:1.

49. (Cancelled) The computer-readable medium of claim 48, wherein said instructions are arranged for polishing at the second removal rate under conditions such that dishing within the dense array is about 300 Å or less.

50. (Cancelled) The computer-readable medium of claim 45, wherein said instructions are arranged for polishing at the first and second removal rates on a rotating, stationary, or linear fixed abrasive polishing pad mounted on the first and second platens.

51. (Cancelled) The computer-readable medium of claim 50, wherein said instructions are arranged for rotating the first and second platens during polishing at the first and second removal rates by at less than about 60 rpm or first and second belts disposed on the first and second platens are moved linearly at a rate of less than about 30 inches per second.

52. (Cancelled) The computer-readable medium of claim 50, wherein said instructions are arranged for CMP a plurality of substrates and cleaning the polishing pads by removing debris and CMP by-products between each substrate.

53. (Cancelled) The computer-readable medium of claim 50, wherein said instructions are arranged for delivering the chemical agent to the polishing pad or the substrate surface at a flow rate of about 300 milliliters per minute or more.

54. (Cancelled) The computer-readable medium of claim 50, wherein said instructions are arranged for recycling the chemical agent.

55. (Cancelled) The computer-readable medium of claim 50, wherein said instructions are arranged for controlling the removal of particles during polishing at the first and second removal rates by controlling the static etching rate up of the substrate

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surface up to about 150 Å per minute or less by controlling the amount of inhibitor in the chemical agent.

56. (Cancelled) The computer-readable medium of claim 50, wherein said instructions are arranged for exposing the polishing pad or the substrate surface to an inhibitor after polishing at the first removal rate and prior to initiating polishing at the second removal rate.

57. (Cancelled) The computer-readable medium of claim 45, wherein said instructions are arranged for exposing the polishing pad or the substrate surface to an inhibitor after polishing at the second removal rate and prior to initiating removing the barrier layer.

58. (Cancelled) The computer-readable medium of claim 45, wherein said instructions are further arranged for

exposing the polishing pad or the substrate surface to an inhibitor after polishing at the first removal rate and prior to polishing at the second removal rate;

exposing the polishing pad or the substrate surface to an inhibitor after polishing at the second removal rate; and

recirculating the chemical agent.

59. (Amended) A method of planarizing a wafer surface, comprising:

a step for removing a portion of a copper containing material with a first abrasive-free polishing composition at a first removal rate; and

a step for selectively removing a copper containing material with a second abrasive-free polishing composition at a second removal rate less than the first removal rate.

60. (Amended) The method of claim 30, wherein the method steps for processing a substrate surface comprise a series of instructions disposed in comprise a computer-readable medium adapted to implement instructions for planarizing the wafer surface by a chemical mechanical (CMP) system when said instructions are arranged

and executed by one or more processors connected to the chemical mechanical (CMP) system.

Please add new claims 61-70 as follows:

61. (New) The method of claim 30, wherein the first abrasive-free polishing composition comprises:

about 1 wt.% to about 10 wt.% of an oxidizer;

about 0.05 wt.% to about 0.20 wt.% of an inhibitor;

about 1.0 wt.% to about 5.0 wt.% of a first chelating agent;

about 3.0 wt.% to about 15.0 wt.% of a second chelating agent;

and deionized water.

62. (New) The method of claim 61, wherein the first abrasive-free polishing composition comprises:

about 6 wt.% of hydrogen peroxide;

about 0.15 wt.% of 5-methyl benzotriazole;

about 3 wt.% of iminodiaetic acid;

about 9.0 wt.% of ammonium hydrogen phosphate; and

deionized water.

63. (New) The method of claim 30, wherein the second abrasive-free polishing composition comprises:

about 0.05 wt.% to about 6.0 wt.% of an oxidizer;

about 0.03 wt.% to about 0.15 wt.% of an inhibitor;

about 0.5 wt.% to about 2.0 wt.% of a first chelating agent;

about 1.0 wt.% to about 6 wt.% of a second chelating agent; and

deionized water.

64. (New) The method of claim 63, wherein the second abrasive-free polishing composition comprises:

about 3 wt.% of hydrogen peroxide;

about 0.06 wt.% of 5-methyl-benzotriazole;

about 1.0 wt.% of iminodiacetic acid;
about 3 wt.% of ammonium hydrogen phosphate; and
deionized water.

65. (New) The method of claim 30, wherein polishing the substrate on the first platen is performed at a first polishing pressure and polishing the substrate on the second platen is performed at a second polishing pressure less than the first polishing pressure.

66. (New) The method of claim 65, wherein the first polishing pressure is about 3 psi or greater.

67. (New) The method of claim 65, wherein the second polishing pressure of less than about 3 psi.

68. (New) The method of claim 65, wherein the first polishing pressure is 3 psi and the second polishing pressure is 2 psi.

69. (New) The method of claim 36, wherein the first polishing pad and the second polishing pad are maintained at a temperature of about 50°C or less during polishing the substrate surface.

70. (New) The method of claim 30, wherein the fist abrasive free polishing composition comprises a corrosion inhibitor concentration between about 0.05 wt.% and about 0.20 wt.% and the second fixed abrasive polishing composition has a corrosion inhibitor concentration between about 0.5 wt.% and about 1.0 wt.%.

REMARKS

This is intended as a full and complete response to the Office Action dated June 19, 2001, having a shortened statutory period for response set to expire on September 19, 2001. Claims 30-60 are pending in the application. Claims 30-44 and 59-60 stand rejected by the Examiner. The Examiner has withdrawn claims 45-58 from consideration. Applicants cancel claims 45-58 without prejudice. Applicants present